THE AERONAUTICAL JOURNAL.

JANUARY, 1900.

The Aeronautical Journal.

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NOTICES OF The Aeronautical Society.

A Meeting of the Council was held on December 5th, when the following gentlemen were elected Members of the Society :—

Mr. CHARLES LYELL.

Mr. WILLIAM ALFRED SOUTH.

The following lady was elected an Honorary Member of the Society :—

MISS ELLA PILCHER.

RESOLVED—

The Council of the Aeronautical Society of Great Britain take this opportunity of recording their sense of the valuable services contributed by the late Mr. Pilcher to the subject of aeronautics, and feel the great loss which the Society has sustained by his untimely death in carrying out his practical aerial experiment.

The Council also desires to express their deep sympathy with Miss Pilcher, an Honorary Member of the Society, in her irreparable loss.

The Council of the Aeronautical Society, at their meeting to-day, take this the earliest opportunity since the departure of Major B. F. S. Baden-Powell on service in South Africa to record their best thanks to him for the great interest he has shown in the affairs of the Society, and for the very efficient manner in which he has conducted the duties of Honorary Secretary since the decease of the late Mr. W. Breary.

The Council look forward to giving Major Baden-Powell a hearty welcome on his return to England.

ERIC STUART BRUCE,
Honorary Secretary, pro tem.

The Departure of Major Baden-Powell.

On the occasion of the departure of the Scots Guards from Chelsea Barracks for South Africa, on the morning of Saturday, October 21st, a deputation from the Aeronautical Society of Great Britain, including Sir William Crookes, F.R.S., Mr. Hiram Maxim, and Mr. Eric Stuart Bruce, attended to wish Major Baden-Powell a hearty farewell, and a safe and a speedy return. Hopes were expressed that the present war would give opportunities for the use of the War Kite, with which his name has been so prominently associated. Many letters and telegrams were received by the Deputation from those who were unable to be present, and amongst those who thus joined in the good wishes of the Society were Major H. C. Roberts, Mr. E. A. Barry, Mr. E. P. Frost, J.P., Dr. Leslie Earle, and Major Fullerton, R.E.

During the absence of Major Baden-Powell in South Africa, Mr. Eric Stuart Bruce will act as Honorary Secretary to the Aeronautical Society, and will edit the "Aeronautical Journal." All communications should be addressed to him at 19, Campden House Road, Kensington, London, W., until Major Baden-Powell's return.

Owing to the widespread interest taken in the aerial experiments of the late Mr. Percy Pilcher, the Aeronautical Society has arranged with the management of the Crystal Palace for the exhibition of his flying machines, which will be shortly on view.

Major Baden-Powell, in a letter to Mr. Eric Stuart Bruce, dated Modder River, December 14th, sends the following interesting description of the use of the British War Balloons in South Africa :—"There is a balloon section here (and another at Natal) under Captain Jones, R.E., with Lieut. Grubb

and Earle. An ascent was made at the attack on Magersfontein on December 11th, and the balloon was up all day, giving much valuable information as to the effect of shell fire, etc. On 15th the balloon was towed out to take part in a reconnaissance, but a very high wind prevailed, which rendered an ascent impossible. While being held down on the ground an extra strong gust of wind caused a big rent, by which all the gas was lost."

The Balloon at the Front.

There could be no better opportunity for displaying the value of the balloon as an adjunct to war than the fierce campaign now in progress in South Africa. Its use in one position alone—that of Ladysmith—has justified the expenditure that our Government has sanctioned in forming what is undoubtedly the finest military balloon equipment in the world, so far as the observation balloon is concerned. To reconnoitre the enemy, is, indeed, the principal use to which balloons are at present applied in the British Army, and critics will be inclined to wonder why so many other uses of balloons of war are apparently neglected by the aeronauts at the front. Why, it is asked, have no experiments been in progress during these years of peace towards attaining an air craft that is navigable, or so far navigable as to be able to proceed against such light winds as have Captains Krebs and Renard in their navigable balloon "La France." This balloon is said to have made a return journey to the place whence it started five times out of seven ascents. Though the successful experiments were only accomplished on practically calm days, in war time a calm day might be utilized for carrying despatches or taking photographs in such a balloon.

Again, the usefulness of electric balloon signalling in such a hilly country as the Transvaal is obvious, and since the system which has been described in this journal found favour with the Government experts who purchased apparatus for its working, it is being asked why the system which, by its altitude, makes visual signalling independent of the configuration of the country is not being widely used in the hour of urgent need by the signalling service?

But we have not far to look for the reasons for any omissions in extending the balloon service beyond the use of reconnoitring. It must be remembered that the balloon section of the British Army, as it exists to-day, is of very modern date, so modern that a comparatively few years ago balloons in our army were only represented by a balloon committee, who were much hampered in the slenderness of the grants they received for carrying out their expensive experiments. During the years 1885 and 1886 so much scepticism as to their utility existed that fears were entertained as to the ultimate position of the British war balloon. But the power of individuality saved the situation. Fortunately for the balloonists, the Inspector General of Fortifications at that time was General Sir Andrew Clarke. It was his keensightedness that foresaw the day when Great Britain would need her balloon eye, it was his enthusiasm that won for the aerial experiments fairer consideration and ampler funds, until repeated experiments on field days and in autumn manœuvres gradually dispelled both prejudice and scepticism, and secured for the balloon a decisive recognition. When more adequate grants first came to hand, it was expedient to partly expend them on mere necessaries, for instance, to replace the sheds in which the balloons had been made and stored at Chatham by the factory which has now been erected at Aldershot. Colonel Templer, the superintendent of the balloon factory and instructor in army ballooning, in concentrating his first efforts on one important branch of military ballooning and making that as perfect as possible under the difficulties with which he had to contend, has displayed his wisdom, though he doubtlessly will not hesitate in the future to extend his efforts to those other branches of ballooning where his exceptional talents are also wanted.

Perhaps the strongest point concerning the National Balloon Equipment is the material out of which the balloons are constructed, viz., goldbeater's skin. The adoption of this material was nothing short of a stroke of genius on the part of Colonel Templer and Major Elsdale. For some time past balloons had been made of this material, and sold in abundance by opticians, but to the above-mentioned officers belong the honour of making large balloons to carry passengers of this material, and securing the services of the workman who had for years made the toy balloons.

Balloons made of goldbeater's skin have the advantage of retaining the gas much

longer than balloons made of varnished silk or cambric, for there is no varnish in the market that is successful in retaining the subtle hydrogen or near the mark in accomplishing this. There is a tradition on the Continent that in the early days of ballooning there was a fairly gas proof varnish, and that the secret was lost. If so the chemist may do a real service to aeronautics in rediscovering it.

Another advantage of goldbeater's skin balloons is that they do not easily heat, while the ordinary varnished balloons are notorious for heating. The former can, therefore, be stowed away with safety. In the issue of this journal for October, 1899, extracts from the official report of Lieut.-Colonel J. E. Maxfield, U.S. Volunteer Signal Corps, to the chief signal officer U.S.A., are quoted under the title, "War Ballooning in Cuba," page 83. It is related how the United States balloon corps, when they wanted to use the old balloon after the landing of the troops at Daiquiri, found that the extreme heat had softened the varnish so as to cause the parts of the envelope to stick together, with the result of "scorching," which rotted the balloon. This "scorching" is almost an every-day occurrence with balloons made of varnished silk or cambric if they are packed up without attention. Their manipulation requires the utmost care, which in transport cannot always be afforded. Even during manufacture an ordinary varnished balloon may burst into flame if the weather is fairly hot and the ventilation of the factory insufficient. The writer has seen the partial destruction of a balloon of 100,000 cubic feet capacity in a few moments during its manufacture on a warm spring day in too confined a place.

A third, but all-important advantage of the goldbeater's skin balloon is its extreme lightness, compared with balloons made of other materials. Fill a small goldbeater's skin balloon of a few inches diameter with ordinary coal gas, and it will ascend; fill a cambric balloon of the same size with the gas, and it does not move upward; make the latter ten times and more the size, and it remains a dead weight. Thus the use of goldbeater's skin secures a much smaller sized balloon for a given lifting power than varnished cambric and silk. In reference to the report above quoted, Lieut.-Col. Maxfield says at the conclusion of it, that balloons employed in military reconnaissance should be of at the least 18,000 cubic feet capacity. But our British war balloons can be only of 10,000 cubic feet capacity, and thoroughly efficient. The reduction in the size of the balloon by the use of goldbeater's skin does not only reduce the size of the balloon, but also the weight of the balloon equipment. When cylinders of compressed gas are taken out to the scene of operations to fill the balloons, the balloon of 10,000 cubic feet capacity would only require about eighty-four steel tubes to fill it, each of these being about 8 feet long, 5⅜ inch diameter, weighing some 70 lbs., and containing 120 cubic feet of hydrogen. If, on the other hand, a balloon of 18,000 cubic feet capacity is used as is officially recommended in the United States, the number of tubes required would be not so very far short of double the number.

A fourth advantage of the goldbeater's skin balloon is strength. At first sight the material would seem too fragile, for most persons are familiar with goldbeater's skin as the thin transparent plaster which is used for a cut finger. But the desideratum of strength can be obtained by combining layers on layers of the substance to any desired thickness by an ingenious process designed by Colonel Templer and Major Elsdale. The balloon exhibited so long in the War Department of the inventions exhibition at South Kensington was a tough and robust specimen of a skin balloon, and it displayed its power of retention of hydrogen, remaining day after day untouched without its shape being lost. It was only at long intervals that the sapper brought his replenishing tubes. But goldbeater's skin balloons are expensive. They may be the balloon luxury of a Government, though almost beyond the reach of the ordinary aeronaut.

The system adopted by our Government of compressing the gas in steel cylinders, and taking them to the place of operation, is undoubtedly handier than filling the balloon direct from the manufacturer's apparatus, and in the former way it can be done with far greater speed. The one disadvantage of the steel tube is the chance that one may prove an explosive bomb, being almost as destructive as lyddite if more than the right quantity of gas is compressed into the cylinder. An ingenious inventor has, however, lately taken out a patent for obviating all risks of explosion, and by the use of the device it will be impossible to compress more than the right quantity into the cylinder. Concerning the

manufacture of hydrogen, experiments have been carried out at Aldershot lately with the electrolysis method of procuring pure hydrogen on a large scale, the apparatus having been designed by Messrs. Siemens. The special advantage of the electrolytic method is the purity of the hydrogen, and consequently greater lifting power for a given quantity.

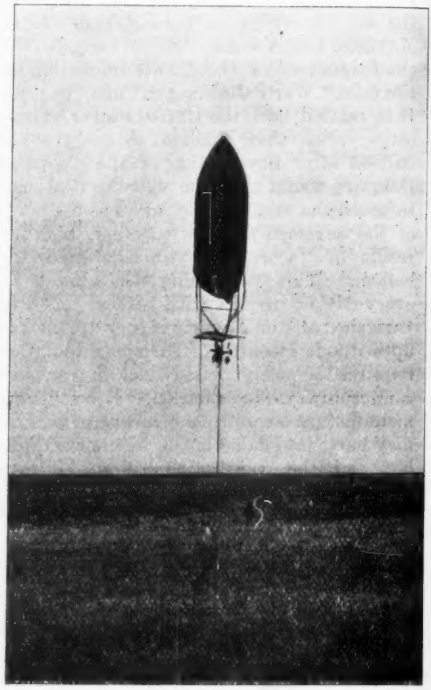
The captive observation balloon has during the siege of Ladysmith frequently ascended, and its usefulness has been reported in the columns of the daily papers. It has been pointed out by the "Graphic" correspondent that the translucent South African atmosphere peculiarly lends itself to balloon observation, that in manœuvres in England the range of a balloon's effective vision at a height of 1,000 feet is not more than some seven or eight miles, whereas in South Africa it is ten or twelve miles. By means of the observations from the car of the balloon at Ladysmith the Boer guns have been located, and our artillery fire has been made decisive and accurate. A little to the right or a little to the left is often the message telephoned down to earth from the officer in his elevated position, and that little has made all the difference. If our Naval guns have saved Ladysmith they owe much to the balloon.

The usefulness of the balloons has been acknowledged by the enemy. According to the "Morning Post," of December 16th, an official despatch from Commandant Cronje says "The British are greatly assisted by balloons."

As to the chances of a balloon being destroyed by the enemy, practical experiments at Lydd have shown that a balloon may be almost rifled with bullets in its lower portion, and yet remain in the air owing to the upward pressure of the hydrogen gas. Artillery fire is more formidable, but this is not very appalling to the occupants of the car, as the "Graphic" correspondent states in the experiments at Lydd a 13-pounder field gun was turned on to the balloon when it was 1,000 feet high, at a range of 4,000 yards. The balloon was not struck till the seventeenth shot. Balloon experts consider a balloon quite safe if sent up three miles from artillery. In case of accident, however, it would seem desirable that balloon scouts should be well practised in the skilful use of the parachute in case they may have by its means to precipitate themselves to earth.

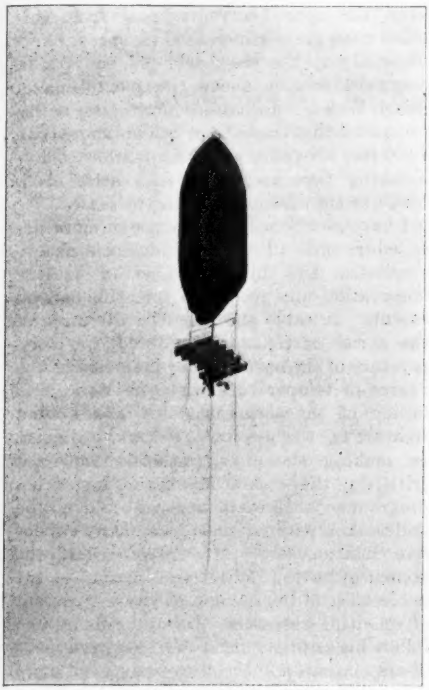
Dr. K. Danilewsky's Aerial Experiments.

At the Aeronautical Congress at the last Paris Exhibition, M. Aimé urged that that improvement in regulating the vertical motion of balloons was the first necessity for aerial navigation. Few inventors have taken heed of his useful suggestion, though many efforts have been concentrated on the control of the horizontal movements of



aerial machines. In the issue of this journal, published January, 1899, some details concerning Dr. Danilewsky's experiments appeared (page 6). By his apparatus he claimed to have so far improved the vertical motion of the balloon that twenty-five ascents were made in an hour and a half to the height of 280 feet. He also claimed being able to control the horizontal movements of his machine in calm weather. Dr. Danielewsky has sent several photographs of his improved direct-

ible flying machine to the "Aeronautical Journal," one of these is reproduced. Further details of Dr. Danilewsky's latest experi-



ments will be awaited with interest, and it is hoped that we may be able to furnish them in an early number of this journal.

The Valveless Balloon Voyage.

BY A FELLOW OF THE ROYAL METEOROLOGICAL SOCIETY.

When the astronomers next announce an exceptionally brilliant display of the Leonids, for the sake of the balloonists who make elaborate and costly preparations, it is to be hoped they will be more accurate in their calculations. The spectacle of seven shooting stars is in itself scarcely worth such a risk to life and limb as the Rev. J. M. Bacon experienced in his ascent in search of the meteors. But the scientific observer gains fresh experience from every journey he makes into the upper strata of the atmosphere, and probably Mr. Bacon has accumulated a sufficient number of facts to repay him for the suspense and discomfort endured.

The ascent was made under exceptional circumstances. Mr. Bacon, his courageous daughter, and Mr. Stanley Spencer, entrusted themselves to a valveless balloon; for if we accept the term valve in its legitimate sense, the arrangement provided for ripping open the top of the balloon and letting the gas out once and for all cannot be called a valve. It is easy to criticise apparently rash proceedings in balloon management, but the aeronaut in charge had a difficult task appointed him when he was instructed to have a balloon moored and ready to start at any moment during two consecutive nights, and it was to prevent leakage and enable the balloon to be adequately full of gas at a given moment that the ordinary valve was dispensed with.

Mr. Bacon has supplied a graphic account of his experiences in the "Times," that newspaper having commissioned him to make the ascent. He thus describes the start:—"The sky remaining overcast we followed the advice given us, and shortly after 4 a.m. took our places in the car, and amid a cheer from many hundred onlookers, quickly mounted to the region where a murky canopy hung overhead. This canopy, proved to consist of a dense wetting fog, 1,500 feet thick. In traversing it, the balloon, which had remained captive in the still warm air of a mild November night, became heavily charged with condensed vapour, and at the same time greatly chilled. The consequence was that it became necessary to discharge a great quantity of ballast to enable us to penetrate the cloud. Even then the balloon again and again sank back into the mist. Only at my earnest entreaty that we should keep well above in view of the stars, and contrary to his better judgment, Mr. Spencer continued to throw out ballast till no less than seven bags had been discharged in 20 minutes."

In planning his valveless balloon, the aeronaut had probably not anticipated this early sacrifice of ballast, which was sufficient to account for much of the subsequent history of the ascent, which was an object

lesson in the sensitiveness of a balloon to the temperatures it encounters.

Mr. Bacon vividly describes how, when day had dawned, and the first beams of sunlight warmed the gas, the balloon, which had appeared lifeless in the moisture-laden cloud, and on the verge of descending to earth, suddenly became inspired with a new life and ascensional force, and mounted up by leaps of 600 feet in every quarter of an hour, till by 9 o'clock it had reached an altitude of 6,000 feet, and was still rising. It is explained that to rip open the balloon at that elevation would have been madness, and that there was no alternative to drifting at the mercy of the currents in ignorance of the whereabouts of the balloon, whether its course was over land or sea. But the suspense of the situation did not blind the travellers to the grandeur of the spectacle that in the early morning spread beneath them. If they had been cheated of falling stars, they were partly compensated by the grandeur of the cloud phenomena! "Several thousand feet below us was spread out, bathed in the intensely bright sunlight, a cloud sea of exquisite beauty. Away to an infinitely distant horizon stretched rolling billows of snowy whiteness, broken up here and there into seeming ice fields with huge fantastic hummocks. Elsewhere domes and spires reared themselves about the general surface, or an isolated Matterhorn towered into space. In some quarters it was impossible to look without the conviction that we actually beheld the outline of lofty cliffs overhanging a none too distant sea."

This captivating narrative goes on to say how, as time went on and the gas expanded under the increasing heat of the sun, the balloon relentlessly continued its vertical course. We are told that at one moment the aneroid registered 9,000 feet, and then the balloon was moving upwards We are not, however, told what was the highest point reached in this remarkable ascent, a fact which would have been of great interest. The time records of altitude do not seem to have been completely kept, as Mr. Bacon mentions that at 12 o'clock the travellers were astonished to find that the balloon had dropped 2,000 feet. The reducduction of lifting power was undoubtedly owing to the meeting of cold currents. It is thought that at the moment that the reduced height of 7,000 feet was noticed, the balloon was crossing the Bristol Channel. "Undoubtedly it was some cold current blowing up the estuary of the Severn that first gave the downward motion to the balloon. Moreover, the upper currents must from this point have greatly increased in speed, blowing stiffly up the sea reach, and eddying in wayward courses above the mountains of South Wales." In half an hour's time it was estimated that the balloon was not more than 1,000 feet above the cloud floor below, "now breaking here and there into little black bits, like snowfields beginning to thaw."

I have mentioned the absence of more detailed records of the altitudes attained to emphasize the intense value of minute observation and record in scientific balloon ascents. A table showing the direction of the aerial currents encountered, the temperature of the currents, the influence of the degree of temperature with the rising and falling of the aerial machine, would be a treasure for the meteorologist and physicist. In making these suggestions, I am not criticising the work of Mr. Bacon, for such a programme as above-mentioned could not be undertaken without the aid of many expensive instruments. Mr. Bacon bears the honour of having revived in this country the noblest use of the balloon as the instrument of scientific research. He and others who follow his example need the hearty support of associations and societies—nay, even more than this, they call for Government aid in providing the sinews of experiment in the shape of substantial grants.

Much must be risked when the advance of knowledge is at stake. In the past, when the British Association took an interest in scientific ballooning, a balloon car has been equipped with most costly apparatus, transforming it into a physical laboratory, with its varieties of thermometers, barometers, hygrometers, and chronometers, and on the descent the balloon came down with a shock that broke nearly every one. But the few scientific facts accumulated during the ascent by Mr. Glaisher were considered sufficient to compensate for the accidental destruction of the means of acquiring them, and before the next ascent the instruments were replaced. Meteorologists often wonder why the British Association left off its patronage of aerial research. Probably it had some good reasons for a temporary cessation of the work, but there are many good reasons why it should resume it. Of the meteorology of the upper

atmosphere we know as yet next to nothing, and the science of meteorology is almost entirely confined to what should be a subordinate branch, "Terrestrial Meteorology." But it is doubtless on the movements of the upper currents undisturbed by terrestrial influences that the laws which regulate weather changes largely depend, and the systematic study of these should add to our power of weather forecasts, which may in the future not be a matter of hours, or even days, but weeks and months.

But to return to Mr. Bacon's adventures. When the dissolving clouds were first revealing glimpses of those ruddy fields that betokened that the balloon was threading its way over the south-west corner of England, even now the balloon seemed hesitating whether or not it would descend. "Each downward plunge was eagerly watched, timed, and recorded, but each ended with a pause, and then a re-ascent. Our monster balloon was dying very hard by sheer slow leakage of gas only."

But at last it sank into a layer of cloud whose chilling influence did the work of compressing the gas, and taking the last life out of the unmanageable balloon. It is not mentioned whether Mr. Stanley Spencer found it necessary to rip open the top of the balloon. The ground was struck with violence, and in a remote corner of South Wales the gusts of wind blew the balloon against various obstacles with such force that Miss Bacon's forearm was broken, and Mr. Bacon's clothes were partly torn from him. At last the ballon caught in a half-grown oak, in which the anchor held, and here ended the journey.

One incident of this ascent is especially worthy of notice, as it records a successful communication with the earth from a height of two miles. While the balloon was drifting at the mercy of the aerial currents and their temperatures, the happy idea occurred to Miss Bacon of throwing down written messages of distress, and three dozen of such messages, folded up as three-cornered notes and marked important in red chalk went overboard. It might be thought that the chances of one of these coming to hand were remote, but future balloonists in distress may take comfort in the thought that one of these distress notes was actually picked up at Pontypridd, and that the person who held it would have carried out the suggestions for help it contained had he not learned in time that the balloon had descended before reaching the sea coast.

It has been claimed that this balloon voyage is a record for England as far as the actual time the balloonists were up in the air. This was ten hours, but this time has often been exceeded on the Continent, where the descent is not hurried for fear of the sea. News has, indeed, lately come to hand of the balloon voyage of Count de Saint Victor and M. Mallet. They travelled from Paris to Sweden in a balloon, and it is said the entire journey occupied 23 hours.

But according to the accounts published in the journal of the "Société Française de Navigation Aérienne," this record of 23 hours has now been beaten by Le Comte Henry de la Vaulx et Le Comte de Castillon de Saint Victor, in the balloon l'Aero Club. It is stated that these aeronauts remained in the air for 29 hours and five minutes. This is the longest known record in the whole world. Possibly unknown to the world, M. Andrée and his companions have made a longer one.

Scientific Research in Aeronautical Problems.

By H. A. B.

The bearing of pure scientific research on practical scientific developments has been demonstrated again and again; and interesting and valuable as are all aeronautical attempts, it is more than probable that the solution of flight and aerial navigation may be achieved after all by the physicist or the meteorologist. Just now, this thought is borne in on us by the physical experiments to determine the resistance of the air of M. L'Abbé Le Dantic and M. Canovetti, and by the publication of the annual bulletin of the Meteorological Commission of the Bouches du Rhône. There are some observations in this of the direction, frequency, and force of the wind made at the Marseilles Observatory at the height of 75 m. Such observations are preliminary steps to a meteorological knowledge of the conditions of the lower and upper atmospheres essential to the making of any seasonal maps of the winds; without such maps many practical aeronauts who look to utilising the wind forces for the purposes of motion consider aerial navigation doomed to remain empirical.

These Marseilles observations at the height of 75 m. are of the eight predominant winds, taken every 6 hours, from 7 in the morning till 10 at night; the force is noted for each degree that such a wind blew at such an hour, and is represented by 0 none, 1 weak, 2 moderate, 3 pretty strong, 4 strong, 5 very strong, 6 violent.

Monsieur Robert Guerin has communicated to "La France Aerienne" the interesting tables that resulted of the meteorological year 1897-98, and tables of the mean of frequency and force for the last 25 years, and the following table of the classing of the 8 winds from the 6 daily observations is from his paper.

The general predominence of the north-west and west winds is apparent; but the preliminary tables of the 6 observations, both for 1897-98 and the mean of the preceding 25 years, showed that at 10 in the evening the predominant wind was north-east, it was also the fairly predominant wind at 7 in the morning. This year's table, like those of some past years, shows a variation from the mean of 25 in the predominance of the north-east over the west wind.

	Meteorological Year. 1897-1898.		Mean of last 25 Years. 1874-1898.	
	Frequency.	Force.	Frequency.	Force.
N.W.	103·3 ..	2·2	104·1 ..	2·4
W.	52·2 ..	1·4	63·6 ..	1·4
N.E.	62·0 ..	0·6	53·5 ..	0·6
E.	38·8 ..	1·2	45·6 ..	1·3
S.W.	39·5 ..	1·1	36·1 ..	1·1
S.E.	35·7 ..	1·5	35·1 ..	1·7
S.	17·5 ..	1·5	17·3 ..	1·5
N.	13·3 ..	1·4	6·4 ..	1·6
No wind ..	2·7 ..	„	3·5 ..	„

It would be interesting to know what was the instrument used to measure the wind force? These instruments have received much attention in England at the hands of the Royal Meteorological Society, and their records teem with considerations of the merits of the various forms of wind velocity and wind pressure gauges, and anemometers. In Great Britain we are not entirely neglecting the compilation of wind records at heights, and these, with French records, pre-eminently on account of the height of the tower, the Eiffel tower work, will furnish invaluable data for the formation of the aeronautical wind-maps of the future.

A consideration of the work of MM. Le Dantic and Canovetti leads us away from meteorology to the experiments of the physicist. Their experiments were carried out in connection with the *Société d'Encouragement pour l'Industrie Nationale*, who, recognising the importance of a knowledge of the resistance of the air to moving bodies, offered a prize for experimental work in investigating "the reactions on a surface moving through the air under varying conditions as to form and velocity." "Nature" gives an illustrated account of the experiments done by MM. L'Abbe, Le Dantic, and Canovetti, drawn by G. H. Bryan from the papers they communicated to the bulletin of the Society, and from report on them by M. Barbet.

Few probably know the difficulties in the way of the determination of the weight of a cubic centimetre of absolutely pure water. But such exact determinations are the very essence of scientific advancement. An example of the value of the minutest calculations was evinced not very long ago by the classic researches of Lord Rayleigh, which led to the discovery of Argon. It was nearly as difficult for M. Le Dantic to get a large volume of air free from all currents, so as to obtain accuracy in his experiments, as it has been for others to weigh a cubic centimetre of pure water. In M. Le Dantic's experiments the feeblest air currents would have detracted from their accuracy. He therefore selected the chapel of the Conservatoire des Arts et Metiérs, which was a closed building sufficiently large for the walls not to affect the stream lines of the air flowing past the moving surface.

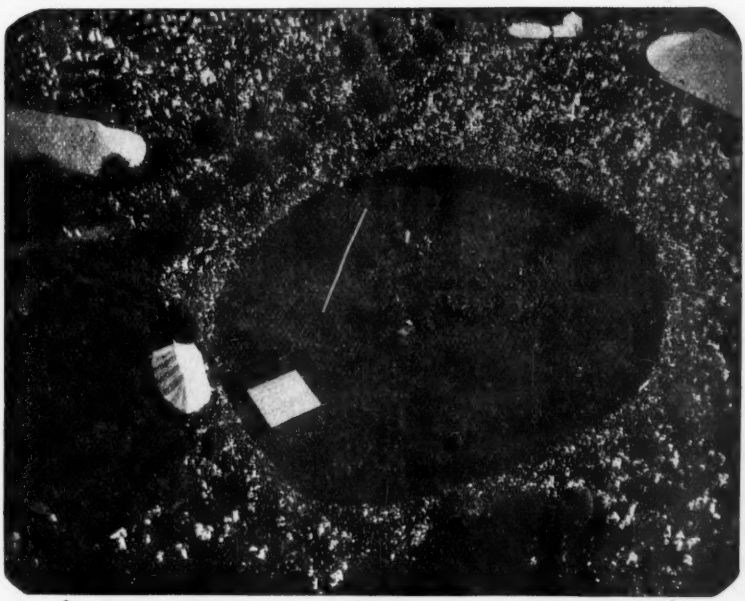
In his experiments the surface whose resistance has to be measured is caused to slide down a vertical wire which acts as a guide without affording perceptible friction. The weight and area of the surface is easily and accurately measured, and the time of its fall estimated with precision by an electric recording apparatus. M. Le Dantic found that 1 square surface, 1 metre square, moving with a velocity of 1 metre per second, experienced a resistance of 81 grammes. Experiments with surfaces of same area, but of different forms, viz., circular, square, and in the shape of a equilateral triangle show that the resistance of a surface of given area is proportional to the length of its contour. This latter appears to have been newly discovered in these experiments. For velocities varying within certain limits the law of proportionality of the

resistance to the square of the velocity is verified.

M. Canovetti's experiments were much more of the rough and ready type than those of M. Le Dantic. In his method the surfaces to be tested are suspended on a trolley which runs down an inclined copper wire, three millimetres in diameter and 370 metres in length, of which one end was fixed on the side of a hill, and the other on the level ground at its base. Owing to the wire hanging in a catenary, the difference of inclination parts of the course interfered with the accuracy of the experiments, the motion not being uniform. It is, however, rather remarkable that M. Canovetti's experiments do not show a greater discrepancy with M. Le Dantee's than they do. For instance, M. Canovetti obtains 90 grammes for the resistance of a rectangle, where M. Le Dantee finds 81. But in scientific investigation it is the next to nothing that is all important, and the greater accuracy of M. Le Dantic's experiments will compensate for the greater labour he expended on their preparation.

Photography from Balloons.

During the past season, I have taken aloft on several occasions a Frena camera which carries forty films on celluloid packed flat like a pack of cards, and have made "snapshots" of the scenery over which the balloon has crossed. There is considerable difference between the results obtainable in different atmospheric conditions, but it is generally possible to obtain photographs when at less than 500 feet in height. Above this height a great deal depends upon the amount of haze on the earth. Sometimes even up to 10,000 feet a picture may be obtained, but often exposures made at this altitude and at other heights down to a thousand feet are not successful, owing to the veil which prevents the actinic power of the reflected light from the earth penetrating through to the sensitive film in the camera. As examples, I append a picture taken at Wolverhampton at a height of 250 feet. This shows the immense crowd around the balloon enclosure, with upturned faces gazing at the de-



parting balloon. The next picture shows the City of York with the minster, old wall, and houses taken from an altitude of 500 feet. The third picture is looking down on the Crystal Palace from 1,000 feet high, and the last shows the town of Hastings, with the sea and piers forming a harbour, taken from a height of 5000 feet on the occasion of the cross-Channel trip I made in company with

Mr. Pollock on July 29, 1899. During next season I shall hope to obtain further data of this most interesting branch of aëronautics, and perhaps the assistance of friends with cameras to accompany me on balloon voyages and thus obtain photographic records of our trips.

PERCIVAL SPENCER.

The Forthcoming International Aeronautical Congress.

The Executive Committee of the Paris International Aeronautical Congress of 1900 has sent a most cordial invitation to the Aeronautical Savants of Great Britain to take part in its proceedings.

The Congress will be held at the Meudon Observatory. The date does not appear to be finally fixed, as efforts are being made to hold it as near as possible to the dates of the Meteorological Congress in consideration of the close relationship which exists between Aeronautics and Meteorology. The Executive Committee includes many distinguished scientists. The president is M. Janssen, the director of the Meudon Observatory. The general secretary is M. Triboulet, the secretary of the Société Française de Navigation Aerienne and editor of the French Aeronautical Journal. Amongst other members are M. Aimé, the secretary of the Paris Aero Club, Dr. Angot, M. Arson, Professor Baille, M. Caillettet, M. Cornu, M. De Fonvielle, M. L'Hoste, and M. Mascart; a list o names which show the high place aeronautica science has attained in the country which is the birthplace of the balloon, and ever been foremost in its use and development.

Those who wish to take part in this important Congress should communicate with the secretary, M. Triboulet, 10, Rue de la Pépinière, Paris.

The following are some of the subject proposed for discussion:—

1. Aerial Navigation.

Ballons libres—Stabilité du ballon dans la verticale. Perfectionnement des moyens d'arrêt et des organes de Manœuvre en L'air. Perfectionnements à apporter à la technique de la construction de ces engins (étoffes, vernis, filets, &c.). Contribution à l'étude théorique des ballons libres, tant au point de vue statique qu 'au point de vue dynamique (déplacements verticaux, résistance de L'air, vitesse des mouvements) &c.

Ballons Captifs.—Mode de suspension et d'attache du càble. Appareils mécaniques d'ascension et de descente. Moyeau de communication avec la terre ; emploi éventuel de la télégraphie et de la téléphonie sans fils. Protection des ballons captifs contre la foudre. Choix d' une forme rationnelle pour la ballons captifs. Contribution à l'étude théorique de ces ballons.

Ballons Dérigeables.—Moteur legers. Résistance des carénes aériennes ; étude expérimentales. Form rationnelle à donner aux ballons dirigeables. Stabilité de la route. Stabilité longitudinale. Moyens de manœuvre dans le verticale. Gouvernails presentation de projéts, d'études théoriques et d'expériences se rattachant à cet important sujet.

Aviation.—Etudes théoriques et experimentales sur les appareils de sustentation, celle-ci étant dépendante on indépendante du mouvement horizontal du navire aerien. Stabilité des appareils d' aviation et notamment des aéroplanes. Etude historique de cette question encore si nouvelle.

2. The Scientific Applications of Aeronautics.

En astronomie.—L'observation de étoiles filantes. La mesure de la radiation solaire, &c.

En Météorologie. — L'étude thermique, chimique, actionométrique, spectroscopic et hygrométrique de l'atmosphere, l'observation des nuages et des divers, l'étude des phénoménes électrique, des vents des hautes regions, &c. La météorologie ne sera une science complète que lorsque aura été possible de l'étudier en ballon d'une façon régulière dans toute l'entendeur globe.

Les cerfs-volants, qui ont été l'objet récemment de trés grands perfectionnements et qui atteignent aujourd'hui des hauteurs de plus de 3,000 metres, pervent de leur côté apporter une contribution trés efficace aux diverses études météorologiques.

Les sondages aériens par ballons non montes fourniront egalement des renseignements précieux quand ils serouf exécutés par séries régulières et organisées après entente entre les divers pays civilises.

En phyiologie. Determiner les caractères graphiques du pouls et de la pulsation du cœur et les comparer à ceux qu'on à observés à des altitudes semblables dans les ascensions de montagnes. Mesurer les changements du périmètre de l'abdomen à déverses hauteurs. Déterminer les changements de fréquence de le respiration et la durée relative de ces deux phases. Mesurer la force musculaire avec la dynamomètre, &c.

It will be noticed that some of the subjects proposed for the congress are of the highest importance, and that many are of a very practical nature. They indicate how necessary it is for the improvement of the balloon and for attainment of the knowledge of the principles that regulate flight, that both branches of aeronautics should receive the attention of men of science in its divers branches. To take one example, "The Protection of Captive Balloons from Lightning," this much-needed application demands the talents of the electrician.

Considering the immense importance of the international discussion of these aeronautical needs, it is earnestly hoped that Great Britain will be adequately represented at this important congress, and that many of the members of the Aeronautical Society of Great Britain will be present. That international congresses on scientific matters are a necessity of the age is now fully realised in this country. Great Britain has in fact been much to the fore in encouraging international co-operation. Each succeeding year shows that the great Parliament of science—the British Association —tends to become more and more international in its character. It is, in fact, fast becoming a great centre of cosmopolitan interest. Last year it selected Dover for its annual meeting-place, chiefly because it was so near the town on the other side of the Channel, in which the French association had elected to hold their meeting. By that friendly movement on the part of the British Association, the distinguished men of science of each nation intermingled in each other's sections, to say nothing of the pleasant social international gatherings that gave recreation and relief after the sterner sectional proceedings.

As most of the flourishing branches of natural science, chemistry, physics, geography, geology, physiology, and meteorology have each in late years been expanding their horizons under the benign influence of international congresses, so, too, will the young science of aeronautics develop and grow maturer under the influence of the diverse thoughts and ways of many nations tuned into harmony by international congresses. In attending international scientific congresses, where men of various nations are striving after one end only, the discovery of truth, besides furthering the advance of any particular science, each is aiding in the great movement which must in the end tend towards consolidating the peace of nations. It is the opinion of many of the distinguished men of science in different countries that the spread of science through the medium of international scientific congress is steadily making for peace. To quote the words of Sir Michael Foster, in his Presidential Address to the British Association at Dover last September :—

"Moreover, not in one branch of science only, but in all, there is a deep undercurrent of influence sapping the very foundations of all war. As I have already urged, no feature of scientific inquiry is more marked than the dependence of each step forward on other steps which have been made before. The man of science cannot sit by himself in his own cave weaving out results by his own efforts, unaided by others, heedless of what others have done and are doing. He is but a bit of a great system, a joint in a great machine, and he can only work right when he is in due touch with his fellow workers. If his labour is to be what it ought to be, and is to have the weight which it ought to have, he must know what is being done, not by himself, but by others, and by others not of his own land, and speaking his tongue only, but also of other lands and of other speech. Hence it comes about that to the Man of Science the barriers of manners and speech which pen men into nations become more and more unreal and indistinct. He recognises his fellow worker wherever he may live and whatever tongue he may speak, as one who is pushing forward shoulder to shoulder with him towards a common goal, as one whom he is helping and who is helping him. 'The touch of science makes the whole world kin.'"

ERIC STUART BRUCE, M.A. Oxon.

NOTES.

Lord Rayleigh on "Flight."—Lord Rayleigh, the Professor of Natural Philosophy at the Royal Institution of Great Britain, is announced to give a Friday evening discourse on "Flight" at the Royal Institution on Friday, January 19th next. That so profound a mathematician, so sound a philosopher and so fertile an experimenter should have taken up this important subject and consider it worthy of his time marks a new era in aeronautics. It should do much towards dispelling the popular prejudice which has to some degree existed concerning the subject. No longer can the epithet dreamer be applied to anyone because he is a student of aeronautics. Like all other scientific subjects, aeronautics has its dreamers. Those who imagine that by merely indulging in a moment's fancy, committing it to a piece of paper and presenting it to the Patent Office, they have without observation or experiment solved the most difficult problem in the world. How Lord Rayleigh will treat this fascinating subject, and how far he will hold out hopes of man's attainment of the flying art is still unknown, and his discourse is awaited with the most intense interest and curiosity.

A Possible Use of Montgolfier Balloons in War.—Mr. Henry Coxwell has lately addressed a letter to the "Standard," in which he proposes the use of Montgolfier hot-air ballons in war, in places which do not admit of the transport of the ordinary balloons and their appendages When reconnoitring close upon the heels of a mobile enemy, he considers the Montgolfier principle would be specially valuable, and he suggests that the inflating power might in an emergency be obtained from mere straw. "With such a balloon made from a new material—which is an animal substance, and now manufactured, I am told—the ascent could be easily managed if the balloon were used without netting or heavy appendages, and it would be suitable for rapid observations, and for getting clear of the enemy before any harm could be done to it, as the inflation and exhaustion of such a machine could be accomplished expeditiously. Under the more favourable auspices of such a new departure, the concealment of the Boers beneath the river banks and the massing of them before they entered their ambuscades

might perhaps have been seen in the nick of time." Like most opinions of this aerial expert, this seems to be one that is thoroughly practical.

The Application of Wireless Telegraphy to Balloons.—The "Engineer" has lately commented on a proposal whether wireless telegraphy might not with advantage be used to explode and release shells carried up by passengerless fire balloons. The position of such a balloon might be followed a long way off by observers stationed at the extremities of a sufficiently long base line to give some measure of accuracy, and on the signal being given the shell might be released with a view of destroying armies and cities. The "Engineer," however, considers that there are difficulties in the way of such an aerial bombardment. "It is very difficult, perhaps impossible, to cause the balloon to travel exactly over the desired spot. If the directing or starting point is ten miles off, it may be questioned if the balloon would ever travel over a desired mark of small area; and if the mark is of large area, it may be questioned what good would be effected by it. We know in fact that it has been deliberately laid down by high authorities that in the attack of a fortress all shells are wasted which do not strike an actual gun or a magazine. This must, no doubt, be subject to some modification; but it is generally true that the useful targets are very small objects, such as it would be hopeless to get a free balloon plumb overhead from a distance approaching ten miles. Thus the balloon attack would resolve itself into one of general bombardment. This is open to grave objection. It generally means a useless destruction of life and property, for rarely indeed has any reasonably strong place been captured by such means. Further, at the Hague Conference, if we remember rightly, this particular form of attack was one given as an example of brutal, unpermissible warfare." But if the aerial balloon bombs are condemned, ought not the same censorship to be applied to the torpedo, which, not visible like the balloon, but hidden beneath the surface of the water, and fired from a distance with serpent-like wilyness, destroys whole warships and thousands of lives. Few will be keen on recommending the adoption of aerial bombs, but Peace Conferences should be logical.

The Duke of Argyll on the Zeppelin Air Ship.—Up to the date of going to press, no news concerning experiments with the Zeppelin air ship has come to hand, and the event of a trial trip is still awaited with interest. Owing to delay, some are asking whether, after the vast expenditure lavished on the air ship, the world is going once more to be disappointed? But in such a prodigious and novel undertaking, delays are inevitable and perhaps expedient, and it will be wise for the public to reserve its opinion until further news arrives.

The Duke of Argyll, who for years has been a profound student of avian flight, has thus criticised the Zeppelin method in a letter to the "Times." The Zeppelin air ship is constructed on a principle directly the reverse of that on which Nature solves the problem when she has to deal with it. In the case of the Zeppelin air ship, the whole structure is to be lighter than the air it will displace. Whereas in the case of flying animals, every one of them is constructed on the opposite principle of weight-lifted and guided by mechanical energy. "There is not a flying animal in the world, from the smallest midge to the largest bird, like the condor, which is not always heavier than the air in which we stupidly describe it as 'floating.' If you worked the organs of mechanical energy, every flying animal falls like a stone." No one will deny the soundness of these views; but in the absence of any complete knowledge in the way of imitating the "glorious and exquisite mechanism of avian flight," it would seem expedient to improve the balloon as far as possible, even if it is destined only to be a temporary and imperfect instrument of air navigation. For after all, at the present moment, the balloon is the only means by which we can rise in the atmosphere to a height of five or more miles, and there, with instruments of research, unravel its mysteries.

* * * * *

We understand that the Central Aeronautical Establishment that M. Georges Bescançon, the Aeronautical Engineer, has been managing has just been amalgamated with the large Aeronautical Factories of Champ de Mars, which belong to the well-known aeronaut Edward Surcouf, and have been re-constructed at Billancourt.

M. Georges Besançon, the aeronaut, is

leaving off manufacturing balloons so that he may exclusively devote his attention to the study of aerial navigation, aerial experiments, and scientific balloon ascents.

Obituary.

While this journal is in the press, we have received the news of the death of the famous aeronaut, Mr. Henry Coxwell, who was an honorary member of the Aeronautical Society. It would ill befit the memory of the great balloonist to devote only a few words to his career of usefulness. We therefore hope in the next number of this journal to give an account of his life and experiences.

Foreign Aeronautical Periodicals.

L'AERONAUTE (Paris).

Octobre, 1899.—Séances des 5th and 19th Octobre, 1899 de la Société française de Navigation Aérienne.—L'Ascension de M. le Comte de Castillon de St. Victor.—L'Ascension du ballon l'Aéro Club. Le Record de la durée du monde entier. Deux Jours et Deux Nuits dans les Airs. Voyage à travers la France.—Préces inédit des travaux faits à L'Académie des Sciences de Paris, pour la perfection des machines Aérostatique, rèdige par le Général Meusnier.

Novembre, 1899.—E'loge de M. Gaston Tissandier par M. J. Janssen.—Séance de 2 Novembre, 1899, de la Société française de navigation aérienne.—Ascension de "La vie au grand Air."—Ascension du "Centaure."—Congrès international d'Aéronautique.

LA FRANCE AERIENNE (Paris).

15 au 31 *Octobre*, 1899.—La sélection du Colombier: E. Caillé.—Colombophilie et automobilisme: G. Guibourg.—Observations météorologiques à marseille: R. Guérin.—L'avant-Garde de Paris: E. Caillé.—A la volée.—Alea jucta est (suite): E. Cruchet.—Aéronautique au jour le jour.—Expédition Andrée.

1 au 15 *Novembre*, 1899.—Bulletin météorologique mensuel.—Marine et Colombophilie: De la Rochelle au Phare des Baleines: Docteur Ox.—La Colombophilie à L'Elysée.—Fédération Colombophilie à L'Elysée.—Fédération Colombophile de Lyon.—La France aérienne en vendée.—Le Messager de L'Océan.—Pigion.—A propos du Ballon dirigeable: G. Guibourg.—L'espérance de Caen.—A la volée.

15 au 30 *Novembre*, 1899.—Brélan de Congrès: Dr. Ox.—L'Aéronatique à l'Exposition de 1900: G. Guibourg.—La Colombophilie au jour le jour.—La Manche de Dieppe.—A la volée.

1 au 15 *Decembre*, 1899.—Bulletin météorologique mensuel.—Nos Sports à l'Exposition de 1900; L'aviateur Rose: C. Jobert.—L'avenér de l'aviation.—Académie d'aérostation météorologique de France.

15 au 30 *Decembre*, 1899.—Silence aux Pauvres: Dr. Ox.—L'Aéronautique à l'Exposition de 1900.—Les Science aériennes au jour le jour.—Aèrostat système de L'ingénieur A. Rallu.

ZEITSCHRIFT FUR LUFTSCHIFFAHRT (Berlin).

October.—Beiträge zur Kenntniss der atmosphärischen Elektricität.—Buttenstedt, Perpetuum mobile und Schwerkraft-Spannung.—Kleinere Mittheilungen: Dienstbach, zur Berichtigung.—Dienstbach, zu Herrn G. Koch's Erwiderung.—Platte, der Weg Zam Zicle ist den Aviatikern durch die Natur der dinge für immer verschlossen.—Buttenstedt, zu Stentzel's Ausführungen.—Buttenstedt, Eine Kleine Bemerkung.—Vereinsnachrichten: Deutscher Verein zur Förderung der Luftschiffahrt zu Berlin.

November.—Beiträge zur Kenntriss der atmosphärischen Elektricität (Fortsetzung).—Mimführ Flugtechnische Betrachtungen I.—Kleinere Mittheilugen: Platte die Irriehre vom Wellenfluge.—Dienstbach, zur Theoretischen Beurtheilung der Kress'schen Druchenfliegers.—Weissse, Emil Jacob über Buttenstedt.—Vereinsnachrichten: Deutscher Verein zur Förderung der Luftschiffahrt zu Berlin.

Notable Articles.

Oct. 3. *Times.*—Letter to the Editor, "Military Ballooning." HENRY COXWELL.

7. *Spectator.*—"The Art of Flying."

7. *Daily Graphic.*—"The Late Mr. Pilcher." (By one who knew him.)

7. *Field.*—"Aerial Flights."

13. *The Practical Engineer.*—"Aerial Navigation."

14. *Spectator.*—"The Art of Flying." Letter to the Editor by E. F.

Oct. 21. *Standard.*—"Despatch Balloons in War." Letter to the Editor by HENRY COXWELL.

24. *Times.*—"Aerial Ship." Letter to the Editor by THE DUKE OF ARGYLL.

27. *Engineering.*—"The Lifting Power of Air Propellers." Letter to the Editor by HORATIO PHILIPPS, and H. W.

Nov. *Fortnightly Review.*—"The Art of Flying." By W. E. GARRETT FISHER.

1. *Daily Graphic.*—"Balloons in War." (Illustrated.)

3. *Engineering.*—"The Lifting Power of Air Propellers." Letter to the Editor by SIDNEY H. HOLLANDS.

8. *Sketch.*—"Science and War." (Illustrated.) (The Deputation of the Members of the Aeronautical Society of Great Britain, including Sir W. Crookes, F.R.S., and Mr. Hiram Maxim, bidding farewell to Major Baden-Powell on his departure to South Africa.)

10. *Engineering.*—"The Lifting Power of Air Propellers." Letter to the Editor by W. G. WALKER, A.M.I.C.E.

11. *Land and Water.*—"The Sport of the Future."

21. *Times.*—"In Quest of the Leonids." By the REV. J. M. BACON.

23. *Times.*—"Mr. Bacon's Balloon Voyage.' Letter to the Editor by EDWARD J. FORSTER.

23. *Nature.*—Note on the Application of Science to Modern Warfare.

Dec. 10. *New York Herald.*—M. Santos-Dumont in his Balloon. (Illustrated.)

22. *London Letter.*—"Balloons in War."

Applications for Patents.

(*October, November, December*, 1899.)

20,739. October 17. CYRUS ARMITAGE, 30, Park Row, Leeds. **Improvements in, or in Connection with, Aerial or Flying Machines.**

21,848. November 1. JOHN WORTHINGTON, Beach Avenue, Blackpool. **Improvements in Flying Machines for Conveying Human Beings through the Air.**

22,763. November 15. JOHN JONES, 41, Reform Street, Dundee. **A New or Improved Flying Machine or Air-Ship.**

23,313. November 22. JOSEPH JOHN WILFRED HAMILTON, The Abbey, Penzance. **The Flying Machine Balance.**

23,314. November 22. JOSEPH JOHN WILFRED HAMILTON, The Abbey, Penzance. **The Square Flying Machine.**

23,605. November 27. JOHN JONES, 41, Reform Street, Dundee. **A New or Improved Flying Machine or Air-Ship.**

24,047. December 2. ALFRED JULIUS BOULT, 111, Hatton Garden, London. **Improvements in or Relating to Air-Ships or Vessels.**

24,393. December 7. REGINALD MANSFIELD BALSTON, 46, Lincoln's Inn Fields, London. **Improvements in Flying Machines.**

24,394. REGINALD MANSFIELD BALSTON, 46, Lincoln's Inn Fields, London. **Improvements in Fluid Pressure Motors Suitable for Use in Flying Machines, Road Vehicles, and other Apparatus.**

24,777. December 13. JOHN JONES, 197, Princes Street, Dundee. **Improvements in the Construction and Apparatus of Air-Ships and Flying Machines, and the Method of Raising, Propelling, and Guiding the same.**

24,848. December 14. FRANCIS ALEXANDER BARTON, 7, Quality Court, Chancery Lane, London. **Improvements in Navigable Balloons or Flying Machines.**

24,862. December 14. EDWARD REDMOND LINDSEYE, Killooney Lodge, Armagh. **An Improved Balloon, called the Safety Balloon.**

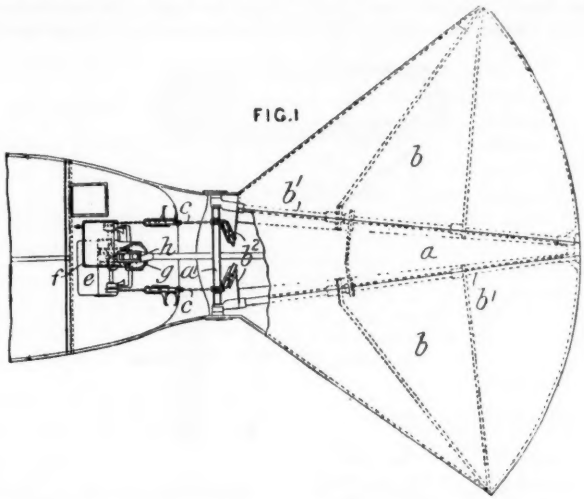
Patents Published.

13,700. June 20. **Flying Machines.** DAVIDSON, G. L. O., 59, Jermyn Street, Middlesex.

Steering.—The machine is kept in equilibrium by a tail composed of three parts *a*, *b*, *b* and shown in plan. The part *a* is capable of turning about a horizontal shaft a^1, and is operated by a vertical screw *g* and nut *h*. The parts *b* turn about shafts

b^1 on the part a, and are operated simultaneously in opposite directions by levers b^2 and chains c. The motors e and f, that operate the chains and screw respectively, are started and stopped automatically by a pendulum mounted on a universal joint.

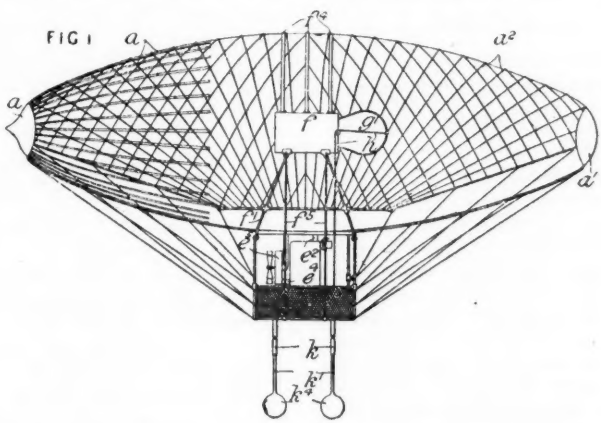
FIG. 1



15,324. July 12. **Aerial Machines.** HITE, C. E., 103, South 34th Street, Philadelphia.

An elongated balloon A of flexible material is protected at the ends by metal caps a, a^1 secured by the netting a^2 and is made rigid in front by rods a^4. It has in its interior a bag which is inflated or deflated according to the pressure of the gas in the balloon A. The balloon communicates with a gas-holder comprising a light metal cylinder containing a goldbeater's skin bag in the car, and the gas in it is continuously circulated by a fan e^5 through a pipe e^4, e^2 in the car heated by a lamp. Propulsion is effected by two fans at the forward ends of the lateral tubes f, which are supported by hinged struts f^1, f^5 projecting from the car and by cords f^4 passing over the top of the balloon, so that, when the latter is deflated, the tubes fall down level with the bottom of the car. A rudder g^1 is pivoted to the side next the bottom of the rear end of each tube f and is drawn more or less across the tube by a cord h. The car carries ballast bags k^4 which are emptied by collapsing them by means of a cord fixed to the bottom inside; the tubes k^1 supporting them may be drawn up inside of the tubes k.

FIG 1



16,181. July 25. **Aerial Machines.** LOCHNER, M., 160, Kantsrasse, Charlottenburg, Germany.

The machines are provided with an aeroplane *e*, Fig. 5, shaped like half a parachute with a rigid forward edge *f* which catches air currents; these air currents escape from beneath the aeroplane at its rear end in such a direction as to give the machine an impulse in the opposite desired direction. A spherical aerostat may be constructed with a stiff inclined band around it, the lower part of the aerostat being folded inwards about this band so as to form an aeroplane. The propellers, Figs. 1 and 2, are constructed so as to act on a similar principle, the direction of the air currents being shown in Fig. 2, which is a section on the line A—B, Fig. 1, and the direction of rotation by the arrows. The front *c* of the propeller is rigid, and the rear *d* of yielding sail material.

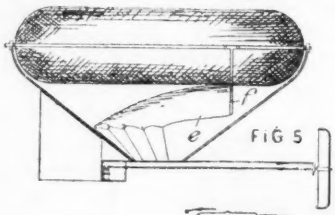


FIG 5

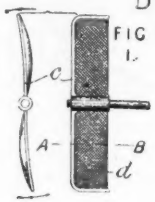


FIG 1.

FIG 2